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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/975,639	10/11/2001	Patricia B. Smith	TI-29811	8363

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EXAMINER

HOANG, QUOC DINH

ART UNIT

PAPER NUMBER

2818

DATE MAILED: 09/24/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/975,639

Applicant(s)

SMITH ET AL.

Examiner

Quoc D Hoang

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 October 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-50 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-50 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

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DETAILED ACTION

Notice to Applicants

1. Applicant's papers filed on 10/11/2002 have been received and entered. Claims 1-50 are pending in the application.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-2, 14, 21, 27-29 and 40 are rejected under 35 U.S.C 102(b) as anticipated over Han et al., (US Patent 6,281,135).

Regarding claim 1, Han et al., Figs. 1A-1I, and related text on col. 1-11 which discloses a method of fabricating an electronic device formed on a semiconductor wafer, comprising the steps of: forming a layer of a first material 14 in a fixed position relative to the wafer, wherein the first material has a dielectric constant less than 3.6 (col. 5, lines 10-67 and col. 6, lines 1-15 and Fig. 1B); forming a photoresist layer 16 in a fixed position relative to the layer of the first material 14 (col. 6, lines 15-20 and Fig. 1C); forming at least one void through the layer of the first material 14 in response to the photoresist layer 16 (col. 6, lines 20-30 and Fig. 1D); and

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subjecting the semiconductor wafer to a plasma which incorporates a gas which includes hydrogen so as to remove the photoresist layer 16 (col. 6, lines 36-60 and Fig. 1F).

Regarding claim 40, Han et al., Figs. 1A-1I, and related text on col. 1-11 which discloses a method of fabricating an electronic device formed on a semiconductor wafer, comprising the steps of: forming a layer of a first material 14 in a fixed position relative to the wafer, wherein the first material 14 is reactive with oxygen plasma (col. 5, lines 10-65); forming a photoresist layer 16 in a fixed position relative to the layer of the first material 14 (col. 6, lines 15-20 and Fig. 1C); forming at least one void through the layer of the first material 14 in response to the photoresist layer 16, wherein the step of forming at least one void further forms a polymeric residue in response to the photoresist layer 16 (col. 6, lines 20-40 and Fig. 1D); subjecting the semiconductor wafer to a plasma which incorporates a gas which includes hydrogen so as to remove the photoresist layer 16 (col. 6, lines 36-60 and Fig. 1F); and removing the polymeric residue by subjecting the semiconductor wafer to a dry plasma (col. 6, lines 36-60 and Fig. 1F).

Regarding claims 2 and 14, Han et al., discloses forming at least one void further forms a polymeric residue in response to the photoresist layer 16 (col. 6, lines 20-40 and Fig. 1D); subjecting the semiconductor wafer to a plasma which incorporates a gas which includes hydrogen so as to remove the photoresist layer 16 (col. 6, lines 36-60 and Fig. 1F)

Regarding claim 21, Han et al., discloses the hydrogen is provided from a hydrogen source selected from a group consisting of H₂, NH₃, N₂H₂, H₂S, and CH₄ (col. 7, lines 1-25).

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Regarding claim 27, Han et al., discloses the first material 14 comprises a carbon-containing oxide (col. 5, lines 10-65).

Regarding claim 28, Han et al., discloses the first material 14 comprises a fluorinated silicon glass (col. 5, lines 10-65).

Regarding claim 29, Han et al., discloses the first material 14 has a dielectric constant less than 2.8 (col. 5, lines 10-65).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 3-13, 15-20, 22-26, 30-36 and 41-46 are rejected under 35 U.S.C 103(a) as being unpatentable over Han et al., (US Patent 6,281,135) in view of Kropewnicki et al., (US Pat 6,440,864).

Regarding claim 30, Han et al., does not disclose removing the polymeric residue by subjecting the semiconductor wafer to a wet etch chemistry.

Kropewnicki et al., discloses in figures 4A-4C and on page 1, lines 1-65 the polymeric residue 60 is removed on the sidewall of a low k dielectric material 45 by subjecting the semiconductor wafer to a wet etch chemistry.

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Han et al., and Kropewnicki et al., are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to use a wet etch process instead of using a dry etching because it is a low cost, reliable and high throughput process with excellent selectivity with respect to substrate material. Therefore, it would have been obvious to combine Han et al., with Kropewnicki et al., to obtain the invention of claim 30.

Regarding claims 3-13 and 31-34, Kropewnicki et al., discloses removing the polymeric residue by using a wet etch chemistry but do not disclose the combination of dilute hydrofluoric acid and an organic acid. Mixing the inorganic acid with an organic acid to obtain a wet etching mixture is considered an obvious design optimization. It would be obvious to combine of dilute hydrofluoric acid and an organic acid to the specified concentration and ratio to obtain the desired selectivity.

Regarding claims 15-20, 31-34 and 41-46, Kropewnicki et al., discloses, after forming a void using photoresist 50 as a mask, removing the polymeric residue 60 comprises subjecting the semiconductor wafer to a mixture of hydrogen, oxygen, and fluorine, wherein the hydrogen in the mixture is provided from a hydrogen source selected from a group consisting of H₂, NH₃, N₂H₂, H₂S, and CH₄; and wherein the fluorine in the mixture is provided from a fluorine source selected from a group consisting of CF₄, C₂F₆, CHF₃, CH₂F₂, SF₆, CH₃F, and NF₃, and wherein the mixture further comprises an inert gas (col.8-10 and Fig. 4A-4C).

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Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claim 22-26, 36-39 and 47-50 are rejected under 35 U.S.C 103(a) as being unpatentable over Han et al., (US Patent 6,281,135) in view of Kropewnicki et al., (US Pat 6,440,864) and further in view of Chien et al (US Patent 6,426,304).

Han et al., discloses a gas mixture contain hydrogen and an inert gas so as to remove the photoresist layer but do not disclose at least 50% hydrogen in the mixture (col. 7, lines 25-35).

Chien et al., discloses a method for striping photoresist from a organsilicate dielectric. Chien et al., disclose a gas comprises a mixture of gases; and wherein the mixture includes at least 50% hydrogen, and a diluent comprises nitrogen wherein the mixture includes approximately 80% NH₃ and 20% N₂ (col. 5, lines 5-65 and col. 6, lines 1-30).

Han et al., and Chien et al., are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to use at least 50% hydrogen in the mixture for striping the photoresist over a low k dielectric. The motivation for doing so is to obtain a highly concentrated hydrogen gas mixtures, hence minimizing the post-strop residue remaining on the dielectric surface. Therefore, it would

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have been obvious to combine Han et al., with Chien et al., to obtain the invention of claims 22-26, 36-39 and 47-50.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Quoc Hoang whose telephone number is (703) 306-5795. The examiner can normally be reached on Monday -Friday from 8.00 AM to 5.00 PM.

If attempt to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms., can be reached on (703) 308-4910

QH
Quoc Hoang

Patent Examiner/ AU 2818

HH
HOAI HO
PRIMARY EXAMINER